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OR COAL MINERS' PHTHISIS

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SPURIOUS MELANOSIS OF CARSWELL

BY J. WARBURTON BEGBIE, M.D.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, EDINBURGH

[REPRINTED FROM THE "GLASGOW MEDICAL JOURNAL"]

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JAMES MACLEHOSE, 61 ST. VINCENT STREET
BOOKSELLER TO THE UNIVERSITY AND FACULTY OF PHYSICIANS AND SURGEONS
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ON ANTHRACOSIS.

A PULMONARY disease, described with sufficient accuracy by J. C. Gregory, William Thomson, Makellar, and others, specially although not exclusively met with in coal-miners, now threatens to become very rare in its occurrence; there are indeed indications of its happily altogether disappearing. The increasing rarity of the disease, at all events in its exquisite or well-marked forms, is a subject intimately, and in a most interesting manner, connected with its etiology, and to this particular attention will at one part of the following observations be directed. In the course of hospital experience I have encountered several instances of well-marked carbonaceous infiltration of the lungs: and in particular have met with two examples of the disease differing very remarkably in many important features from each other, both of which terminated fatally. These cases I propose in the commencement of this communication to place on record.

The circumstance of the existence in the pulmonary structure of a varying amount of black pigmentary matter has long been recognized. Laënnec, in writing of "Mélanosés" of the lungs,* alludes to the discovery of such pigment, more or less abundantly in the lungs of almost all adults, it being found chiefly in persons advanced in life. In the lungs of young persons, on the contrary, he remarks, rarely are any traces to be noticed. The appearance, as regards colour, presented by the lungs of young persons, Laënnec likens to that seen in the same organs in oxen and many other animals, and he hazards the conjecture that possibly the pigment, "*matière noire*," exists only in the lungs of man and of carnivorous animals; adding, however, with characteristic modesty, that his own attention to comparative anatomy had been too limited to admit of his

* "*Traité de L'Auscultation Médiate*," Deuxième Partie, Productions accidentelles développées dans le Poumon.

expressing a confident opinion on that head. What is of greater interest, however, and more immediately connected with the subject of this paper, is the further statement by Laënnec, at the same place, that he has sometimes surmised that the black matter in question may in part at least proceed from the smoke of lamps and combustible bodies used for the purposes of warming and of lighting; and again, that in the lungs, as well as in the bronchial glands, of cottagers unaccustomed to watching or sitting up late at night, the pigmentary matter is either absent or present in very small amount. This experience, Laënnec is careful to say, is not universal; for the discovery of pigment in considerable amount has on the other hand been occasionally made in the lungs of persons in no peculiar manner exposed to the causes just alluded to. The reader familiar with the illustrious work of Laënnec will remember that, although in no degree detracting from the value of the passage to which reference has now been made, there is in the chapter in which it occurs not a little confusion, occasioned by the want of a proper distinction, at the time impossible, between the true melanosis of the lung, an undoubted neoplasm, or new formation of cancerous nature, and the pigmentary substance with which we are at present more immediately concerned. To the disease which is generally known under one or other of the names placed at the head of this paper, but which has also been described as *Carbonaceous Bronchitis* (Dr. Walshe); *Black Phthisis* (Dr. Makellar); *Black Spit* (J. B. Thomson); and *Mélanose du Poumon* (Valleix), the attention of the profession was to a certain extent directed as early as 1813, by Dr. Pearson, writing in the *Philosophical Transactions*, "On the Colouring Matter of the Black Bronchial Gland, and of the Black Spots of the Lungs;" but since that date the following important contributions regarding it have appeared:—"Report of a case of peculiar black infiltration of the whole Lungs, resembling Melanosis," by Dr. J. C. Gregory.* Article entitled "Spurious Melanosis," in the *Cyclopædia of Practical Medicine*, by Dr. Carswell. In the same author's well-known work on *Pathological Anatomy; Illustrations of the Elementary Forms of Disease*, there is a brief description of the appearances presented by the affected lungs; and likewise, under the head of Melanoma, plate 3, an illustration giving a very correct notion of their universal black discoloration. "On the Existence of Charcoal in the Lungs," by Thomas Graham, F.R.S.† "Cases of Spurious Melanosis of the

* *Edinburgh Medical and Surgical Journal*, Vol. xxxvi., 1831.

† *Eodem Loco*, Vol. xlii.

Lungs," by Dr. William Marshall, of Cambuslang.* "On Black Expectoration, and the Deposition of Black Matter in the Lungs, particularly as occurring in Coal Miners, &c.," by Dr. William Thomson.† "Melanotic Infiltration of the Lungs, with old and recent Pleuritis," by Dr. Hamilton, of Falkirk.‡ "An Investigation into the Nature of Black Phthisis," by Dr. Makellar.§ Still more recently a valuable contribution to the pathology of miners' lung has appeared from Professor Virchow, of Berlin;|| and Dr. J. B. Thomson, of Perth, has written an interesting paper on the Melanosis of Miners, giving details of his experience as a practitioner in a colliery district for twenty-four years.¶ In several of the best known and most highly esteemed treatises on diseases of the lungs, allusions more or less extended to this peculiar morbid condition exist, as for example in the work of Dr. Walshe.* Of the papers now mentioned, the most important and complete is that by the late Professor William Thomson, of Glasgow; the references made by that author to the observations and opinions of various writers, ancient and modern, concerning the presence of black matter in the expectoration, obviate the necessity that might otherwise have existed for making a more detailed allusion to the literature of the subject.

The observations which I propose to make on the nature, and more especially on the etiology of carbonaceous infiltration of the lungs, will succeed a brief narrative of the two interesting cases already referred to, as having fallen under my notice in the ordinary course of hospital experience. Several cases of well-marked black expectoration I encountered from time to time; but, with the exception of another instance of miner's lung complicated with mediastinal cancer, the two to which I presently direct attention were the only fatal cases which I have had the opportunity of observing:—

CASE I.—J. D., aged 49, was a patient in the Royal Infirmary for several weeks in the spring and early part of the summer of 1856. He had throughout life worked as an ordinary farm servant, but for some years his occupation had been almost entirely that of attending to a threshing-mill, placed in a low-roofed and confined shed. Here, during fully nine months of

* *Lancet*, 1833-34, Vol. ii., p. 271; also p. 926.

† *Medico-Chirurgical Transactions*, Vols. xx., xxi.

‡ *Eodem Loco*.

§ *Monthly Journal of Medical Science*, 1846.

|| From notes by Dr. Alexander R. Simpson, *Edinburgh Medical Journal*, 1858.

¶ *Edinburgh Medical Journal*, 1858.

* *Diseases of the Lungs*, p. 227.

the year he had worked, in the midst of much dust, from morning till evening; the remaining three months had been devoted to out-door farm work. This man, of sober habits, had not suffered from any chest affection till commencing, some four or five years before his death, the occupation to which reference has now been made. At that employment he had not worked above a few months when he became short in breathing and subject to cough. After a time he noticed his spit to be dark in colour, and gradually to acquire a black or inky hue. He was able, although with much difficulty, to continue at this work till the beginning of 1856, when from general feebleness, and particularly owing to severe cough and difficulty of breathing, he felt compelled to desist.

When brought under my observation in the hospital, this patient had lost flesh and strength to a great extent, and manifested the appearance of a person who had been for a lengthened period suffering from pulmonary disease. The expectoration was very abundant, and very black. The left front of the chest was universally dull on percussion, and immediately under the clavicle there were the marked signs of extensive excavation. Over the right front the percussion resonance was abnormally clear. The patient had at no time expectorated blood. The course of the disease did not differ in any particular from that of ordinary pulmonary phthisis,—hectic fever, night sweats, constant and extremely irritating cough, gradually wore out the poor man's strength. He died on the 2d day of June.

On examination of the body by Dr. Haldane, the following appearances were presented. There was great emphysema of the upper anterior portion of the right lung. That lung was of a uniform dark colour both externally and internally, while on pressure a fluid of similar colour, and staining the fingers, escaped. In this lung there was no marked condensation. The left lung was firmly adherent, and the corresponding side of the chest contracted. The lung was of a very dark colour, non-crepitant in the lower lobe, yielding, on pressure after section, a very abundant inky fluid. In the upper lobe there were several considerable excavations, and a few small masses of tubercle. Bronchial glands were enlarged, and of extremely black colour. Liver and kidneys congested, but otherwise normal.

The most remarkable feature in this case consists in the circumstance that the subject of it was not a coal-miner, or other operative exposed in any extraordinary manner to the operation of those causes, which, as will be shortly seen, are

supposed to engender the disease,—all his life this man had been an agricultural labourer. He was addicted to smoking, but it was ascertained that he did not inhale the fumes as some smokers are known to do. He had not been in any way peculiarly exposed to the inhalation of the smoke of oil-lamps, and had not known other men, engaged in precisely the same occupation, suffer as he had done.

So much for the history of the case. It is further of interest to note, that in the left lung a little tubercle was found co-existing with the carbonaceous matter, and that the right lung was greatly emphysematous.

A careful inquiry, instituted at the time of its occurrence, satisfied me, that this case was the only one of its kind which had ever been seen in the district where D. worked for many years, where his pulmonary affection commenced, and from which, when no longer able to follow his employment, he came directly to the Infirmary.

CASE II.—A. B., aged 53, married, a coal miner, native of Gilmerton, in the county of Midlothian, went to work in a coal mine when twelve years of age, and continued at the same employment till he had reached forty-five; was a healthy man during the earlier portion of his life, but suffered a smart attack of pleurisy in the left side when about thirty. Twenty years ago, that is eleven years before he gave up his occupation as a miner, he began to suffer from a constant black spit, darkest in colour, and most abundant for a short time after leaving the mine, on the conclusion of each day's work. During the last eleven years of his employment as a miner, he was never free from pains in the chest, cough, and expectoration, while a shortness of breathing, at first trivial in degree, became gradually so serious as to compel him, as he had often noticed others among his fellow-workmen compelled, to abandon the calling of a miner altogether. Having somewhat improved in health, he was able for a time to work in the construction of railways, and for a limited period more particularly in tunneling, and in the sinking of wells. For nearly two years has been altogether unable to work; he has during that time been subject to severe irritating cough, with expectoration of black matter, and to greatly increased difficulty of breathing, while his strength and flesh have greatly fallen off. During the same period he has repeatedly spat blood in small quantities. On the 27th of January, 1865, this man came under my care in the Royal Infirmary, he was then much emaciated, and had the appearance of a patient in the advanced stage of phthisis. His sufferings were of a very aggravated description, chiefly from

dyspnœa, and urgent cough. The expectoration was copious, and for the most part not difficult. It consisted of black matter, closely resembling ink, with a good deal of frothy mucus, partially stained, and occasionally a little pus. The chest was considerably flattened under both clavicles, more particularly on the right front; percussion on that side was absolutely dull, and over the upper left front considerably impaired. Loud bronchophony, amounting at one spot over the second rib anteriorly to pectoriloquy, was audible over the right chest. Vocal resonance was increased also over the left sub-clavicular region. Loud and very coarse moist râles, frequently gurgling in character, accompanied a deep tubular sound of breathing over the upper portion of the right front, while, in the lower portions of the right lung, moist râles of finer quality were audible. Posteriorly, the physical signs over the right lung did not differ from these discovered in front, and in the left lung these indicated the existence of pulmonary consolidation with partial softening. Without the previous history of the patient, and still more without acquaintance with the characters presented by the expectoration, there was nothing to distinguish the case of B. from one of ordinary tubercular disease of the lungs advanced to the stage of excavation and disintegration. The sputa, however, did serve thus to distinguish it. I need not particularly dwell on the progress of this case in the hospital. The digestive organs, much affected from the period of his coming under my care, became more seriously disordered: vomiting frequently occurred; rapid declension of strength, with marked hectic supervened; and, without the occurrence of any remarkable symptom, death took place at 2 p.m., of the 25th of February. B. had been occasionally delirious at nights for some time; and the feet had also become œdematous; the urine was scanty, but never contained albumen.

The body of B. was examined on the 26th February, by Dr. Grainger Stewart. The chest was much flattened, the body emaciated; heart enlarged, weight $17\frac{1}{2}$ ounces, its right side dilated, substance of heart not materially altered; the blood fluid but thick and very dark. Right lung densely adherent, contained a large amount of black carbonaceous deposit, and had several cavities towards its apex. The bronchial tubes did not exhibit any marked deposit, but were congested and occupied by much black mucus. The left lung was much less adherent, the upper lobe shrunken, and contained a solid mass of carbon, about the size of an apple; there were also cicatrices deeply coloured at different portions of the surface of this lung. The bronchial glands of both lungs were deeply tinged, and

those in the right lung were the seat of considerable carbonaceous deposition. The liver was congested and fatty; the spleen exhibited on its surface, and also at several points within its substance, depositions of black pigment; the kidneys were large, weighing $9\frac{1}{2}$ ounces each, but their structure, beyond having a congested appearance, did not seem to be abnormal.

This case is, in all its particulars, an extremely illustrative instance of coal miners' phthisis, as it has usually presented itself. The man worked as a coal-miner from his youth, became affected with black spit, and in due time, continuing his occupation in pits,—which were generally regarded as the "worst pits for the lungs," to use B.'s own language,—but seeing that they have long since undergone much improvement, or have ceased to be wrought, I need not name——, he became the subject of cough, and shortness of breathing. Desisting from his employment as a miner, probably his life, already become burdensome, was thereby somewhat lengthened; but, just as in the cases described by Thomson, Graham, Makellar, and others, the progress of the disease was evidently unarrested, and it is now apparent that deposition and softening, with subsequent excavation of the lung substance had been slowly going on during the nine years which had elapsed after his leaving the coal-mines. There are a few particulars in this case which are worthy of special notice.

1. Although I have not dwelt upon this circumstance, in the brief record of the case, I wish it to be understood that this man's sufferings were very great—greater than is usual in instances of ordinary pulmonary diseases, and particularly phthisis. Dr. Makellar has more especially depicted the sufferings of such patients, and my observation of B.'s case has convinced me that the portraiture by him has not been over-drawn.

2. The slowness of pulse, coldness of extremities, and blueness or lividity of countenance, described by some authors, were not noticed in B.'s case. These features, the two former more especially, have been too readily regarded as the concomitants of a morbid condition of the blood, due to the presence of excess of carbon, at least induced by mal-oxygenation. It is not always so, for in fatal cases of bronchitis, and in instances of long existing cyanosis, and pulmonary emphysema, I have observed a frequency of the heart's action, with unusual maintenance of the animal temperature over the whole body, till dissolution itself has occurred: so was it in the case of B.

3. The dilated condition of the right ventricle, discovered on dissection, accords with previous observations, and the pigment-

ary matter found in the substance, as well as on the surface of the spleen, tends to confirm the opinion—to be more prominently set forth in the sequel—that the black matter, whatever its real nature be, is a deposit from the circulating fluid.

The chief or distinguishing character of the pulmonary lesion in this disease is the black appearance assumed by the lungs from the deposition and impaction in their structure of a dark pigmentary matter. Regarding the precise nature of this deposit, as well as its source, a difference of opinion has arisen, and still exists. It is contended, on the one hand, by certain physicians and pathologists—as, for example, by Gregory, William Thomson, Carswell, Makellar, Brockmann, Robin, and others—that the origin of the black matter is “*ab extra*.” That it consists, in fact, of carbon inhaled during the occupation which those who chiefly suffer from this affection pursue. It is confessedly among persons who are much exposed to the inhalation of an atmosphere highly charged with carbonaceous particles that anthracosis mainly occurs. The great majority of such sufferers are coal miners; hence “*Miner’s Melanosis*” and “*Miner’s Phthisis*” have been used as synonymes for the disease. Again, chemical analysis of the black pigment has determined its close resemblance to carbon: indeed, its being identical with carbon. This was done by Dr. Christison in the instance of one of the earliest recorded cases, that by Dr. J. C. Gregory in 1831, and such experiments have since that time been frequently repeated. Boiled with concentrated nitric acid, the black colour remains unaffected, and, after immersion for some time in a strong solution of chlorine, it is found to be equally black as before. Boiled in a strong solution of caustic potash, and then slowly filtered, the black matter remains on the filter, and this, when washed and carefully dried will burn like charcoal, leaving a grayish ash. Not only so, but a small quantity of the powder left after the action of the nitric acid, may, when properly treated, be caused to yield all the products of the distillation of coal and gas, similar in quality to that so produced, a naphthous fluid and crystalline principle called naphthaline. These circumstances must at once be admitted as establishing the carbonaceous nature of this peculiar lung pigment. Whether the extraneous origin of it admits of as conclusive a proof we have still to inquire. But another and contrary opinion to that now expressed is entertained by certain other physicians and pathologists—among these by Breschet—who, indeed, was the first to broach it—by Tronsseau and Leblanc, and more recently, and very decidedly, by the

distinguished Professor at Berlin, Virchow. They conceive that the black matter is altered blood pigment, in reality a transformation of hæmatin, that it is deposited from the blood, and has, therefore, an internal and not an extraneous origin. Virchow thus expresses his notion of the pigmentary changes, viz.—“as resulting from extravasations of blood, and subsequent transformations of hæmatin.” It is not contended in this view that the pigmentary matter is not closely allied to carbon; it is not, indeed, sought to be established that it is otherwise than a form of carbon. An opposite conclusion could hardly be arrived at, seeing that, in chemical constitution, so far as is known, this black pigment and carbon are identical. But, then, we are cognisant of no test which is absolutely distinctive of carbon, and the question still remains: Is there any chemical difference between the black pulmonary substance discovered in anthracosis, and the carbon of coal and of smoke? This view may be otherwise expressed by saying, that, although carbonaceous, the black pigmentary matter found in the lungs, and also expectorated in cases of anthracosis, may not after all be the carbon of coal or of smoke. The chemical experiments of Guillot have shown this pigment to be composed of nearly pure carbon; to be, in fact, much richer in carbon than any form of coal is. It is curious, and likewise instructive, to notice how the different theorists accept and apply these results of a renewed chemical investigation. In the view of Robin, who has always maintained the extraneous origin of the pigmentary matter, the discussion is now to be regarded as closed; the announcement of the results of Guillot’s chemical inquiry leaves nothing more to be done.* These same results are, however, interpreted by Virchow in a manner totally at variance with the conclusions of the former observers.

Regarding the properties, and more especially the chemical relations of the pigment, both parties may be considered as nearly, although not wholly, agreed; but in respect to its primary origin they seriously differ. *One party* views the inhalation of the carbon, and its impaction in the minute bronchial ramifications and the ultimate air cells, as the ready explanation of its presence in the lungs. *Another view* is entertained by Virchow, that it is deposited from the blood, not as carbon but hæmatin, which undergoes transformation; an anthracosis succeeds the sanguineous extravasation. *A third view*, although it has not been brought prominently forward, may be thus stated; the

* See Article VII.—“Charbon Pulmonaire”—in Vol iii. of *Traité de Chimie anatomique et physiologique normale et pathologique, &c.*, par Charles Robin, et F. Verdeil. Paris, 1853.

presence of the black pigmentary matter in the lungs may be, in part, due to the inhalation of minute carbonaceous particles, and in part to the deposition, after some manner or other, of carbon from the blood. It may be contended by those who have formed this last opinion, that the great amount of the deposit in the lungs, its nearly entire limitation to the pulmonary structure, as well as the fact of its steady and often remarkable increase, long after the sufferer has been removed from those circumstances which exposed him to the inhalation of the carbonaceous dust, make this the probable, if not the only tenable, explanation. In regard to this point the inquiry is suggested, whether the carbon—the word is now used as synonymous with black pulmonary pigment—thus deposited from the blood, is a portion of what has been taken into the circulatory system originally at the lungs. That the black matter found in the pulmonary tissue is present in the circulation is at all events deposited from the blood, may be regarded as proved by the fact of the pigmentary substance being found in other situations than the lungs. This statement is, no doubt, opposed to the expressed opinions of Carswell and of others, but it is nevertheless true, for the same black deposit has been discovered many times in the bronchial glands, not unfrequently in the pleura, and, although with much less frequency, nevertheless unequivocally, in the peritoneum, free and intestinal, and in the mesenteric glands. Whether it be the altered hæmatin or the inhaled carbon, and I am disposed to regard the latter as the more likely, which is thus encountered, there can be little doubt that a real deposition from the blood takes place; all of the observed phenomena are not to be explained upon the principle of a simple inhalation and impaction. It is not difficult to understand why, in the later stages of the lung affection incident to coal miners, when a considerable portion of the pulmonary tissue has suffered destruction, the arrest of the carbon should then take place in an increasing ratio alike as regards rapidity and amount. And for this result we should be prepared, whether the carbon be present in normal or in abnormal degree in the blood.

In the disease known as anthracosis or coal miners' phthisis, the carbon exists in the circulating fluid in greatly increased amount. At the lungs there is not that free access of oxygen to the blood in the pulmonary capillaries which is necessary for the combustion of the carbon, and, as a necessary consequence, instead of carbonic acid being exhaled, an always increasing amount of carbon is deposited. Dr. Makellar has stated in strong terms, as the result of his long and attentive

observation of many exquisite cases of "black phthisis," that when once carbon is lodged in the pulmonary structure by inhalation, there is created by it a disposing affinity for the carbon in the blood, by which there is caused an increase in the amount of the deposit without any more being inhaled." A similar opinion too, has been expressed by Brockmann, who acquired his knowledge of the disease as it exists among the miners of the Hartz mountains.*

In the general symptoms presented by the sufferers from anthracosis there exists a close similarity with many cases of tubercular disease of the lungs, and this agreement is also noticeable to a very marked degree, as may have been gathered from the illustrative instances already recorded in this paper, in respect to the physical signs. The distinguishing and highly characteristic feature among the former is the black expectoration. There is often present in the sputa of patients affected by various pulmonary complaints a certain amount of black pigmentary matter; especially will this be noticed in the earlier stage of not a few cases of tubercular disease, and it will generally be found that, in its occurrence and particularly in its amount, the phenomenon in question bears a relation to the nature of the occupation in which such persons have been engaged. This, never otherwise than slight admixture of black pigmentary matter with the sputa, there is really no risk of mistaking for, or confounding with the pigmentary expectoration of anthracosis. In this disease, besides being thoroughly charged with black matter, the expectoration continues thus altered during the whole course of the malady. No doubt certain changes in its characters are likely to occur, and for the most part do present themselves, for, at first mixed with mucus, this ingredient after a time disappears, and a puriform, to be succeeded by a purulent, sputum takes its place—all this time, however, the expectoration has never lost its very black colour.

It is quite extraordinary how large an amount of black matter will, in cases of anthracosis, be got rid of by expectoration. In one instance which was under my own observation in hospital, for a period of several months, the spit-box was daily filled with a dark, heavy mass. I have had from time to time the opportunity of seeing an old man, formerly a collier, now, at least lately, a toll-man, who, for many years, and to a far greater extent after leaving the coal pits than while engaged in them, has expectorated very large quantities of black matter. In this case, as in others I have met with, the expectoration is not constant; for the cough, which always exists, will for weeks

* See *Neumeister's Repertorium*. December, 1844.

together become dry, and while dry always very distressing and painful. After the lapse of a few weeks, occasionally of a longer period, the expectoration again returns, being for a time scanty, but gradually becoming more and more copious. When most abundant, the cough and likewise the dyspnoea are most moderate. Dr. Makellar mentions, that in one of his cases the expectoration, as far as consistence went, had the appearance of treacle, being, however, perfectly black: and of this ten to twelve ounces, were expectorated daily. During his attendance on this patient, Dr. Makellar separated the mucus from the black matter by the simple process of diluting the sputa with water, and thereafter separating the precipitated carbon. In this way he was enabled to procure about $1\frac{1}{2}$ drachms of a beautiful black powder, daily, and in the course of a week he had a supply of nearly 2oz. This, Dr. Makellar informs us, he continued for some weeks, and he might have gone on till the period of the patient's death, several months thereafter. The same writer concludes, "It is undoubtedly a striking phenomenon connected with the pathology of the chest, that the human lung can be converted into a manufactory of lamp black!"

Some curious and interesting points suggest inquiry in relation to the expectoration. For example, among coal miners, the class of operatives chiefly subject to anthracosis, and among them the workers at the stone wall in the pit,—who of all the miners are most frequently affected, and in whom the disease most speedily runs its course—there are very few who are at any time exempt from the black spit. Some there are who have it while at work in the pits, and perhaps for some hours after leaving it, but who find it gone before the stated period of their return to work. Others again, and of this class two interesting examples fell under my observation in the Royal Infirmary during the winter session, 1857-58, and were made the subject of remark at clinical lectures, continue for weeks and months to expectorate black matter: many of them without presenting any of the physical signs or other of the general symptoms of anthracosis. In persons so affected, the inhalation of the carbonaceous particles and their lodgment in the bronchial passages is surely the only satisfactory explanation of the phenomenon. Such patients, for the most part, pay no regard to the black spit; they treat it as a necessary consequence of their subterranean calling, and do not view it as any indication either of themselves being ill, or of their occupation being unhealthy. Some I have seen have sought relief for other affections, as in the instances occurring in hospital already referred to, both of whom suffered from chronic rheumatism. Still, although in many, as yet, a

symptom of no very serious import, it behoves us to bear in remembrance, that in the case of those who have afterwards become the victims of regular carbonaceous infiltration of the lungs, the occurrence of black expectoration has been the very earliest symptom. It will be readily admitted that a free expectoration of inhaled carbonaceous particles is just the most likely circumstance to prevent, at all events, to ward off for a time, its impaction in the air vesicles; and, if this explanation of the pathology of the disease in its earlier stage be essentially the correct one, it is likewise manifest how important an aim it should be to promote in the same stage of anthracosis a free expectoration. In this disease, as in tubercular phthisis, hæmoptysis is not unfrequent; that appears, however, from the cases which have been recorded, seldom to occur in the early progress of the malady, but to be one of the symptoms of the more advanced period when the pulmonary structure has become more or less seriously disorganized. In one of the two cases already recorded hæmoptysis never occurred; in the other case, that of A. B., it took place for the first time about eleven years after his pulmonary ailment had given by other symptoms unmistakeable evidence of its existence.

The same indications of failing health present themselves in this disease and in phthisis, the same loss of strength and of flesh taking place by degrees, more or less gradually in different cases; for anthracosis is essentially a chronic disease, which tubercular consumption is not always. Great emaciation sometimes occurs in anthracosis. Dropsy, unattended by renal affection, is common in its advanced stages; this, as a peculiarly distressing symptom, has been noticed by Makellar and others. Dr. Lawson Tait, who has recently resided in a colliery district, and has had the opportunity of carefully watching a few well-marked instances of the disease, informs me that he was struck by the frequency, as well as by the amount of general dropsical effusion in these cases. Dropsy, with albuminuria, I have also met with, in cases of anthracosis, but rarely. When albumen was present in the urine, it was not abundant, and was unassociated with other and still more significant indications of kidney disease. It was, in all probability, due to renal congestion of a passive kind, primarily to that stasis of blood in the renal capillaries, which, sooner or later, in all diseases characterised by special blood-impurity, results, and is the direct determining cause of serous transudation and albuminuria. Connected with the slight albuminuria thus referred to, I have seen in the urine of anthracosis copious deposition of amorphous urates. I have been much interested in observing, that Dr. Robert Wilson, of

Alnwick, who has had large opportunities of studying the diseases of colliers, makes the remark: "I never seen a case of Bright's disease in a pitman. That the disease is not uncommon in the district may be known from the fact that, at the time I write, I have five cases under treatment from albuminuria, and three of them the wives of pitmen."*

The cough, and difficulty of breathing are, generally speaking, most severe in this disease. The dyspnoea is, in all probability, intimately connected with the extremely impure condition of the blood, which, as the malady advances, ceases to present the characters of the vitalized fluid, and in appearance resembles a very dark and thick venous blood; when, as usually happens, the right side of the heart has become dilated, the resulting breathlessness is extreme, and, as in the case of A. B., most painful to witness. It is at this stage, too, that the general dropsy becomes excessive. The symptoms, moreover, which mark the very advanced stage of tubercular phthisis are often present in anthracosis—the colliquative perspirations, the exhausting diarrhoea, and the wandering mind. The euthanasia, or easy death, not unknown to us in the sufferers from ordinary phthisis, is, I fear, never experienced in the instance of those dying of the disease which is now under consideration. On the contrary, there is, till near the close of life, invariably much suffering, and that of the most distressing nature.

It has already been remarked that the so-called physical signs of disease, in cases of anthracosis, offer a very close resemblance to those which we observe in the different stages of ordinary tubercular disease of the lungs. The varying degrees of dulness on percussion, and of altered resonance of the voice, are not more significant of lung condensed by tubercular deposition, than by carbonaceous infiltration; while the modifications of bronchial breathing, from a merely comparative harshness, limited in situation to a well-marked tubular sound, and even cavernous râle, are, in some cases quite as readily recognised in the one condition as in the other. So, also, when softening and excavation have occurred, the moist sounds, the crepitant and sub-crepitant râle, and the coarser gurgling will be audible in anthracosis just as in phthisis. It is consistent with my own observation, and the two cases which have been shortly detailed will bear out the remark that a vomica, the result of softening, and ultimately

* *The Coal Miners of Durham and Northumberland, their Habits and Diseases.* A paper read before the British Association for the Advancement of Science, at Newcastle, September, 1863. By Robert Wilson, M.D.

of destruction of the pulmonary substance in anthracosis, may have such significant physical signs as cavernous breathing, gurgling râle, and pectoriloquy to distinguish it, and these quite as well marked as when we meet with them in the advanced stages of tubercular disease. This will not always hold true, for the disease we have to deal with, an eminently chronic one, is specially apt to be attended by intercurrent pleural inflammations. Hence, pleural thickenings and dense adhesions, common enough in tubercular consumption, are still more so in anthracosis. It is probably owing to the chronic nature of the disease, but specially from the frequency of pleural inflammation and adhesion, that the occurrence of pneumothorax has not been observed in cases of carbonaceous infiltration of the lungs.

The appearance presented by the lungs when affected by anthracosis is very remarkable. The colour varies from a well marked slate-colour, to a deep, almost jet, black. The external surface usually resembling more exactly the former, while the cut surface presents the darker hue. If the lung is in the early stage of the disease, no excavations having formed, it is voluminous, of increased density, evidently condensed from the occupation of the parenchymatous structure by black pigmentary matter. If subjected to pressure a considerable amount of fluid, dark in colour, flows out, staining in a remarkable manner the hands. So deep is the stain thus caused that it generally requires several applications of soap and water thoroughly to remove it; certain parts of the lungs are generally found to be denser, and the tissue in these more completely occupied by carbonaceous matter than others. A portion of such will readily sink in water, communicating a deep black colour to the water as it passes down through it. Unlike the deposition of tubercular matter which usually commences in the apex, or towards the summit of the lung, this black matter is found equally to invade all portions—the base is as subject to it as the apex. Nor is one lung more likely to be affected than the other; they suffer equally. This experience in regard to carbonaceous infiltration, so opposed to what holds true of tubercular deposition in the lungs, seems again to favour the view of the former being in the first instance, whenever it occurs, due to direct inhalation of minute particles. Were it otherwise, is it not reasonable to suppose that, as is commonly the case with tubercular deposition, the apices of the lung would chiefly suffer, and one lung might be found much diseased, while the other was comparatively unaffected?

It seems to have been at one time imagined that the car-

bonaceous infiltration and the deposit of tubercular matter in the lungs were mutually antagonistic. This opinion seems to be implied in certain of Dr. Makellar's observations, and, were it correct, undoubtedly we should have arrived at the knowledge of a very important fact. Such, however, is not the case; tubercle and this black pigment have been frequently found—the former in all its stages, recently deposited, crude, and softening—in the same lung. In the left lung of J. D. it was so, and I have seen the co-existence of the two, much more notably illustrated in the lungs removed from the body of a patient who died of miners' phthisis, by Dr. Maclean, now of Skye. That, under somewhat different circumstances, tubercle and carbon co-exist in the lung, the result of numerous *post-mortem* examinations testify. It is not uncommon to find in the lungs of elderly or old people the cicatrices of tubercular cavities, in which more or less of black pigment, not distinguishable from carbon, exists, and such lungs do further not unfrequently present throughout their entirety an unusually dark or slaty colour. In the advanced stages of anthracosis cavities are formed. These, like tubercular vomicæ, vary in size. Some are very small, others large, capable of holding an orange; less commonly they are much more extensive. These excavations are generally found to be partially occupied by a thick black fluid similar to what has been expectorated during life. As in tubercular cavities some of the divisions of the bronchia, right or left as the case may be, are seen opening into them. Blood-vessels also shrivelled and shrunken, as in the old tubercular excavations of chronic phthisis, are observed crossing them from wall to wall, and, with these, portions of lung substance in a state of disorganization, and having the appearance of shreds. The most frequent complication of anthracosis is bronchitis, indeed so frequent is it, and so invariable are the evidences of its previous existence, as discovered on *post-mortem* examination—the congested and thickened mucus membrane, and the dilated bronchial tubes—that bronchial inflammation may be considered an essential part of the malady. It is not uncommon to find more or less of emphysema.

It is now necessary to inquire in what part of the lung tissue the black pigmentary deposit originally occurs? This is undoubtedly various. So much so, indeed, that Virchow holds "the deposit may occur in very different parts of the lung in every case, and no classification can be made of different forms of the disease from the position of the pigment." The opinion generally entertained up to the time Virchow investigated the subject, was that the black matter is found free in the air

vesicles, and in the epithelial cells of their walls, while it was limited to this situation. Virchow, however, finds it "free in the alveoli and in the alveolar cells; in the interior of the connective tissue, pleural, sub-pleural, interlobular, and peribronchial; not unfrequently, also, in the costal and diaphragmatic pleura, and always in the bronchial lymphatic glands." Moreover, he maintains that the black matter is never found in the epithelial cells of the bronchi, and further, that it is invariably noticed in the immediate vicinity of blood-vessels. From the circumstance that the black pigmentary matter is never absent from the bronchial glands, the same observer concludes that there is no evidence of a regular progressive absorption, and moreover, that the limited amount of pigment found in the inter-alveolar septa, and its frequent deposit under the pleura, further militate against this view, and are favourable to the notion of a deposition taking place from the blood. An important particular to attend to is the examination of the black substance itself. Virchow admits that it occurs in "all the forms in which particles of coal dust may present themselves." Sometimes larger, sometimes smaller, these particles may be found of round or angular form; occasionally they are flat and possess an almost crystalline lustre, just as is observed on viewing portions of coal under the microscope. To the circumstance that none of the coal particles which he has ever examined having presented a pure black colour, Virchow attaches great importance. The pigmentary particles removed from the lung in cases of anthracosis are purely black, and the difference in colour between these and coal particles is so remarkable that he is led to conclude "that the inhalation of particles of carbon cannot be the cause of the pigmentation." Recently a very interesting case of coal miners' phthisis fell under the notice of Dr. Sanders, and the remarks made by him in regard to it are well worthy of attention. Dr. Sanders observed in the sputum of this patient little hard specks, having all the appearance of coal. One of these specks, nearly of the size of a pin's head, Dr. Sanders sent to Mr James Bryson, optician, to prepare for the microscope, in order to determine whether it was coal or not. Mr. Bryson had succeeded with some difficulty in grinding the fragment sufficiently thin, and, on comparing the specimen thus prepared with a specimen of Dalkeith coal, it was found that they presented an identical structure, consisting of bands of yellow material in a black matrix.*

It is quite conclusive, from this interesting observation that

* *Edinburgh Medical Journal*, September 1864, page 274.

in coal miners' phthisis, fragments of coal, by no means impalpable, do reach the pulmonary structure, and it may reasonably be conjectured that in many other cases, if not in all examples of anthracosis, coal particles in more minute subdivision are inhaled and become firmly impacted.

But in the consideration of the etiology of the subject, it is to be kept in remembrance, that the observation of the disease in the coal pits of Scotland, very early gave rise to the notion that the inhalation, not so much of minute coal particles as of an impure atmosphere charged with the products of burnt carbon, by the burning of oil lamps in the confined situation of the pits, was the really efficient cause of anthracosis. This opinion, alluded to by earlier observers, is very strongly expressed in the paper of Mr. J. B. Thomson of Perth, formerly a practitioner at Tilliecultry, where he had many opportunities of carefully studying the disease. Mr. Thomson has specially grounded the opinion now referred to on the following considerations. 1st. That in all the low workings in the pit where oil is used, large masses of black sooty matter, in strings or in flakes, are seen to adhere to and hang from the corners and roof. 2nd. The colliers themselves regard the burning of the oil as the cause of the black spits and the difficult breathing from which they suffer, and they have observed in many pits, in different parts of the country, that those among them who use the oil lamps are the earliest to fall into bad health and the earliest to die. 3rd. The black spit of coal miners is oily or unctuous, corresponding in this respect with the masses which adhere to the walls of the pit and float through the atmosphere. Mr. Thomson asserts "that the use of oil in mines is injurious and probably the exciting cause of black spit." It was noticed by Dr. Makellar, and the observation received confirmation from others, that those men who were frequently engaged in using gun-powder for the purpose of blasting the stone rock, in order to reach the coal seam, suffered more severely from the disease than did others not similarly employed. This was explained by the men engaged in blasting inhaling an atmosphere highly charged with smoke, for after the immediate action of the gun-powder they returned to their work. The opinion as to the injurious effects of blasting I have found to be one commonly entertained by colliers themselves. And I have been able to corroborate the opinion expressed by Mr. Thomson as to the baneful influence of the oil lamp. Where the burning of the oil lamp has been banished the disease has apparently received a most decided check. A further objection is taken by Virchow to the theory of the inhalation of carbonaceous particles being the cause of

anthracosis, namely, that these particles are not always met with in the form of granules; at times he remarks the pigment is found "in a diffuse form," "so that cells may be seen grey or black, from the penetration of a matter which the highest microscopic power fails to break up into visible granules;" and he further states, that probably in the case of miner's lung, though much more decidedly in those instances of slighter pulmonary pigmentation which are met with from day to day, a gradual change can be traced by the microscope from a yellowish red, or reddish brown pigment, to a perfect black.

In the careful microscopic examination of recent specimens of miners' lung I have been unable to verify the statement of Virchow thus alluded to, and I cannot help suspecting that the peculiarities in colour on which he lays so much stress may have been due to the lengthened preservation in spirit of the portions of lung submitted to his scrutiny. The granular form of the pigment is the only form which I have ever seen the particles removed from the sputa, or the lung itself, when examined, to exhibit.

In this paper the attempt has been made to signalize the chief features whether of pathological or etiological interest in cases of anthracosis. It must be admitted that several points in relation to both of these topics require renewed and still more careful investigation. Upon the whole, however, I feel disposed to conclude that—

1. Anthracosis is primarily determined by the inhalation of carbonaceous particles

2. That in the instance of the coal miner, while capable of being produced in various ways, the chief exciting cause is the inhalation of the very impure atmosphere occasioned by the burning of oil lamps. It would appear that the long-continued inhalation of a very *dusty* atmosphere may, under certain circumstances, engender the same condition. (Case of J. D. detailed in the earlier portion of this paper).

3. That when once the deposition of carbon in the pulmonary structure has taken place to any extent, and the true function of respiration is thereby interfered with, there occurs a tendency which gradually increases to the arrestment of carbon or carbonaceous pigment in the lungs, and its removal there from the blood.

4. That the presence of black pigmentary deposits in the bronchial glands, the pleura, and less frequently the peritoneum and mesenteric glands; makes it probable that there may in cases of anthracosis be some peculiar process of carbonaceous absorption as well as deposition of carbon.

5. That in this view, the opinion as to the black pulmonary deposit being the result of transformation in hæmatin, although supported by so distinguished an observer as Virchow, cannot be considered as so readily reconcilable with what we know of the natural history, and especially the etiology of the disease.

It is extremely desirable that the chemical aspects of this interesting subject should receive renewed investigation, and I would specially invite the chemical inquirer to determine whether the black matter found in the lungs in anthracosis, and that discovered in the bronchial glands, and less frequently in the remoter situations named, be *chemically* identical.

One word in conclusion in reference to the term anthracosis which has been employed in this paper. The expression, not a new one in medical phraseology, because used by some Greek writers to indicate a painful tumour of the eyeball, was first applied to black pigmentary infiltration of the lungs, by Dr. Thomas Stratton, R.N., in an interesting paper, a reference to which will be found below.* The word has also been adopted by Virchow, and, on account of its readily understood signification, it is not unlikely that *anthracosis pulmonum* will retain a place in preference to the longer—and of some it must be acknowledged the inaccurate—expressions which different writers have hitherto employed.

* Case of Anthracosis or Black Infiltration of the whole lungs. *Edinburgh Medical and Surgical Journal*, vol. 49. 1838. p. 490.

